

What is claimed is:

1. A computer-readable medium having computer-executable instructions for a sender of a multicast transmission to  
5 perform steps to provide repair data to a receiver of the multicast transmission, the steps comprising:

receiving a negative acknowledgment from the receiver  
identifying a sequence number of a missing packet of the  
multicast transmission received by the receiver;

10 transmitting a confirmation of receipt of the negative acknowledgment;

setting a back-off time and a linger time based on a  
location of the sequence number within a transmit window  
maintained by the sender for retaining recently transmitted  
15 data of the multicast transmission for data repairs such that  
the response back-off time is shorter as the sequence number  
is closer to a trailing edge of the transmit window;

sending repair data for the missing packet after  
expiration of the back-off time; and

20 waiting for expiration of the linger time after sending  
the repair data for the missing packet and ignoring other  
negative acknowledgments for the missing packet received  
during the linger time.

25 2. A computer-readable medium as in claim 1, wherein the  
step of setting sets the back-off time according to a

separation between the sequence number and the trailing edge of the transmit window.

3. A computer-readable medium as in claim 1, wherein the  
5 back-off time and linger time together form a response dwell  
time that is constant for a session of the multicast  
transmission, and wherein the step of setting sets a ratio of  
the back-off time to the linger time according to a separation  
between the sequence number and the trailing edge of the  
10 transmit window.

4. A computer-readable medium having computer-executable  
instructions for a receiver of a multicast transmission from a  
sender to perform steps to request for repair data, the steps  
15 comprising:

receiving original data packets of the multicast  
transmission from the sender;

detecting a packet missing from the multicast  
transmission;

20 sending a negative acknowledgment to the sender  
identifying the missing packet;

receiving a confirmation matching the negative  
acknowledgment;

25 setting a data waiting timeout according to a statistical  
average time for receiving repair data from the sender and a  
size of a transmit window maintained by the sender for

retaining recently transmitted data of the multicast transmission for data repairs;

waiting for repair data for the missing packet up to expiration of the data waiting timeout; and

5        resending the negative acknowledgment after expiration of the data waiting timeout if the repair data for the missing packet is not received.

10        5. A computer-readable medium as claim 4, wherein the step of setting determines the data waiting timeout based on an estimated time the repair data for the missing packet will stay in the transmit window of the sender.

15        6. A computer-readable medium as in claim 4, wherein the steps of receiving a confirmation, setting, waiting, and resending form a data retry cycle, and the computer-readable medium includes further computer-executable instructions to perform the step of determining whether the data retry cycle has been repeated up to a pre-selected maximum number of  
20        retries.

25        7. A computer-readable medium as in claim 6, wherein the step of setting determines the data waiting timeout according to a number of retries of the data retry cycle already performed by the receiver.

8. A computer-readable medium as in claim 7, wherein the step of setting increases the data waiting timeout with the number of retries already performed for a first portion of the pre-selected maximum number of retries.

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9. A computer-readable medium as in claim 8, wherein the step of setting sets the data waiting timeout for the first portion of the pre-selected maximum number of retries to the statistical average time for receiving repair data multiplied by a factor that increases with the number of retries.

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10. A computer-readable medium as in claim 8, wherein the step of setting sets the data waiting timeout for a second portion of the pre-selected maximum number of retries to a remaining available time of the repair data divided by a remaining number of retries to be performed.

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11. A computer-readable medium as in claim 5, having further computer-executable instructions for the receiver to perform the step of estimating the size of the transmit window of the sender in terms of transmission time.

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12. A computer-readable medium as in claim 11, wherein the step of estimating a number of bytes in the transmit window and dividing the number of bytes by an average transmission rate of the sender

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13. A computer-readable medium as in claim 11, wherein  
the step of estimating includes determining an amount of time  
for a sequence number of a transmitted packet to move from a  
leading edge of the transmit window to outside the transmit  
5 window.

14. A method for a sender of a multicast transmission to  
provide repair data to a receiver of the multicast  
transmission, comprising the steps of:

10 receiving a negative acknowledgment from the receiver  
identifying a sequence number of a missing packet of the  
multicast transmission received by the receiver;

transmitting a confirmation of receipt of the negative  
acknowledgment;

15 setting a back-off time and a linger time based on a  
location of the sequence number within a transmit window  
maintained by the sender for retaining recently transmitted  
data of the multicast transmission for data repairs such that  
the response back-off time is shorter as the sequence number  
20 is closer to a trailing edge of the transmit window;

sending repair data for the missing packet after  
expiration of the back-off time; and

waiting for expiration of the linger time after sending  
the repair data for the missing packet and ignoring other  
25 negative acknowledgments for the missing packet received  
during the linger time.

15. A method as in claim 14, wherein the step of setting sets the back-off time according to a separation between the sequence number and the trailing edge of the transmit window.

5        16. A method as in claim 14, wherein the back-off time and linger time together form a response dwell time that is constant for a session of the multicast transmission, and wherein the step of setting sets a ratio of the back-off time to the linger time according to a separation between the  
10 sequence number and the trailing edge of the transmit window.

17. A method for a receiver of a multicast transmission from a sender to request for repair data, the steps comprising:

15        receiving original data packets of the multicast transmission from the sender;

         detecting a packet missing from the multicast transmission;

         sending a negative acknowledgment to the sender  
20 identifying the missing packet;

         receiving a confirmation matching the negative acknowledgment;

         setting a data waiting timeout according to a statistical average time for receiving repair data from the sender and a  
25 size of a transmit window maintained by the sender for retaining recently transmitted data of the multicast transmission for data repairs;

waiting for repair data for the missing packet up to expiration of the data waiting timeout; and

resending the negative acknowledgment after expiration of the data waiting timeout if the repair data for the missing  
5 packet is not received.

18. A method as claim 17, wherein the step of setting determines the data waiting timeout based on an estimated time the repair data for the missing packet will stay in the  
10 transmit window of the sender.

19. A method as in claim 17, wherein the steps of receiving a confirmation, setting, waiting, and resending form a data retry cycle, and further including the step of  
15 determining whether the data retry cycle has been repeated up to a pre-selected maximum number of retries.

20. A method as in claim 19, wherein the step of setting determines the data waiting timeout according to a number of  
20 retries of the data retry cycle already performed by the receiver.

21. A method as in claim 20, wherein the step of setting sets the data waiting timeout for a first portion of the pre-  
25 selected maximum number of retries to the statistical average time for receiving repair data multiplied by a factor that increases with the number of retries.

22. A method as in claim 18, further including the step  
of estimating the size of the transmit window of the sender in  
5 terms of transmission time.